Two dynamic studies in one MR examination: Three alternative combinations of different dynamic studies

K. Kikuchi[1], Y. Hiratsuka[1], S. Oda[1], S. Kohno[2], H. Watanabe[2], S. Ohue[2], T. Mochizuki[1], and K. Murase[3]
[1]Radiology, Ehime University, Ehime, Japan, [2]Neurosurgery, Ehime University, Ehime, Japan, [3]Medical Engineering, Osaka University, Suita, Japan

Purpose

We demonstrate three alternative combinations to obtain two different dynamic data in one MR examination. Background of this idea is that a 3-T MRI system produces larger signal changes induced by a contrast agent compared to a 1.5T-MRI system. Half the normal dose of contrast agent will bring the sufficient signal changes on 3-T MRI, thus two different dynamic data can be obtained totally with normal dose of contrast agent.

Outline of Content

A combination of 4D-MRA and DSC-MRI (MR perfusion) is considered for patients with cerebral occlusive vascular disease. These two studies provide detailed vascular anatomy and information about cerebral hemodynamics. Another combination involves acetazolamide (ACZ) loading. DSC-MRI can be performed before and after ACZ administration. Cerebral perfusion reserve (CVR) can be calculated using the data, yielding information similar to a SPECT examination.

For brain tumor cases, a combination of T1W dynamic study (DCE-MRI) and DSC-MRI can be used. Data from these studies can provide various parameters, which are thought to reflect hemodynamics in a brain tumor and are expected to be compared to its pathological findings.

4D-MRA data are obtained by 3D T1-FFE (TR/TE/FA = 2.1/1.11/25) with SENSE factor 6 (AP3, RL 2) and keyhole imaging (35%) technique. It provides high spatial resolution (120 slices with 1.2 mm slice thickness) and high temporal resolution (16 dynamic data every 2 seconds). 4D-MRA images are generated by subtracted from mask images and MIP. DSC-MRI data are obtained with 2D-GEEPI (TR/TE/FA = 1200/20/70). 60 dynamic data is obtained at 1.2 seconds time resolution. Hemodynamic images including CBF, CBV and MTT are generated through standard deconvolution algorithm on single value decomposition. DCE-MRI data are obtained with 3D T1-FFE (TR/TE/FA = 2.1/ 0.93/20). 60 dynamic data is obtained at 2.2 seconds time resolution. DCE-MRI data are processed using in-house developed software, and various parameters [tissue blood flow (F), Ktrans (transfer constant) and PS (permeability-surface area product)] are calculated with the tissue homogeneity model.

A 7.5mL of contrast agent is injected at a speed of 3.0mL/sec on each dynamic study. A total of 15mL contrast agent is used in this study. In our experience, the contrast agent used in the first dynamic study does not appear to affect the signal intensity of the second dynamic study.

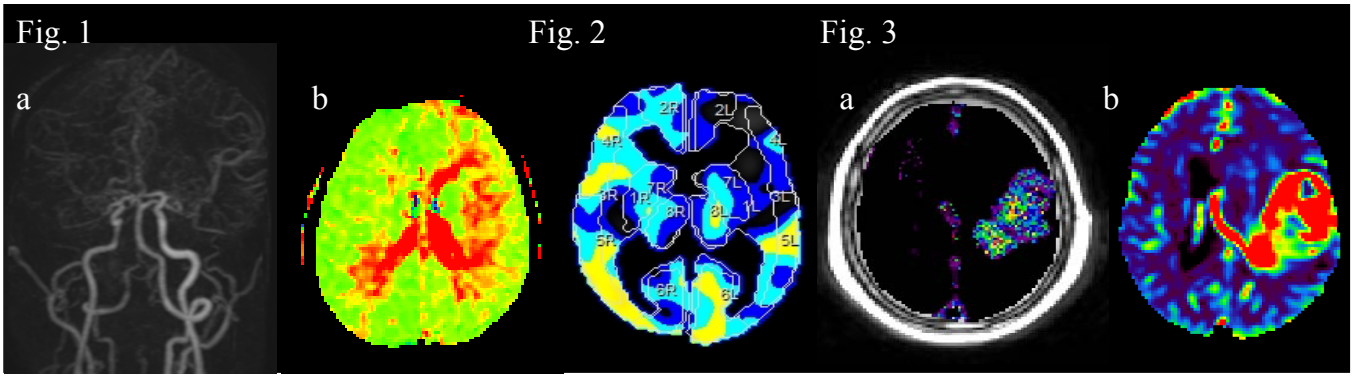

Fig. 1 Moyamoya disease a. MIP image of 4D-MRA shows hypoplasia of bil. MCA. b MTT image calculated from DSC-MRI shows cerebral perfusion impairment in left hemisphere. Fig.2 lt. IC occlusion. CVR image is obtained from DSC-MRI data with ACZ challenge. It shows a decreased CVR in left hemisphere. Fig.3 Glioblastoma multiforme a. Ktrans image obtained from DCE-MRI. b. CBV image obtained from DSC-MRI. These images show high blood volume and high permeability of the tumor.

Summary

In this presentation, we will demonstrate the usefulness of these dynamic studies with clinical cases. 4D-MRA can depict the detailed anatomical changes of cerebral arteries with cine mode. The cerebral hemodynamics can be evaluated by DSC-MRI. DCE-MRI and DSC-MRI can bring various physiological parameters of brain tumor, and these parameters show significant difference among the WHO tumor grades. Our three alternatives will be promising protocols to evaluating cerebral occlusive disease and brain tumors.